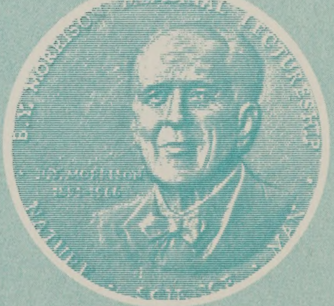
Man and His Home

The 1970 B.Y. Morrison Memorial Lecture



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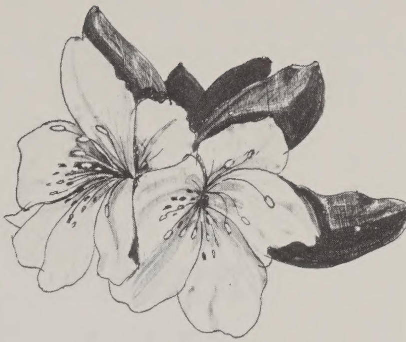

The B.Y. Morrison Memorial Lecture was established by the Agricultural Research Service of the United States Department of Agriculture to recognize and encourage outstanding accomplishments in the science and practice of ornamental horticulture . . . to encourage its wider application to improve the quality of living . . . and to stress the urgency of preserving and enhancing man's environment.

B.Y. Morrison (1891-1966) was a many-faceted man—a scientist, landscape architect, administrator, plant explorer, author, and lecturer. A pioneer in ornamental horticulture, he was the first Director of the National Arboretum, today one of the world's great botanic research and education centers. He gave the American public dozens of new ornamental plants, including the well-known Glenn Dale azaleas. He did much to advance the science of botany in the United States.

Morrison's plant exploration trips to the Orient, Europe, and Latin America made him a nationally known authority on foreign plants. He was one of the first Department officials to encourage introduction of ornamentals. His popular publications were among the first to promote plants to enhance the beauty of the land.

The 1970 B.Y. Morrison Memorial Lecture

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Man and His Home

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Earth finally made it. It, too, had its day. It took some doing, but finally the younger generation got up in arms and organized sit-ins and teach-ins—all for good old Mother Earth.

It was about time. The airplane commuter knows when he is nearing our big cities—haze and brown clouds are the rule. The views from the Empire State Building in New York, the Prudential Building in Chicago, the Humble Building in Houston, or the City Hall in Los Angeles have one thing in common. Visibility is considered good when one can see the outlines of hazy streets below and a horizon covered by a brownish haze.

The waters from the sewers of the big cities and their industries stretch their greenish and brownish effluent far into

the lakes, and we read about the replacement of healthy fish populations by mudsuckers and unsightly fields of algae, choking all other plant life to death. Excessive human deaths during periods of heavy air pollution have been recorded in London, New York, and other cities.

Today, a majority of Americans, urban and rural alike, in all sections of the country live near polluted waters and are breathing polluted air. In some cases, smog is doing more damage to crops than even insects. We have upset the balance of nature because we have assumed that our resources—air, water, and soil—are infinite.

This century has taught us that our space ship is not at all so big and that we have finally succeeded in changing, on a global scale, the composition of our atmosphere and the water of the oceans. The rapid burning of fossil fuel in the last fifty years has raised the concentration of carbon dioxide in the air substantially, and this, together with particulate matter from our industrial operations, will affect the heat balance of the earth.

All these terrifying incidents have brought home to us the realization that we are part of Nature, that there is a close bond between us and our environment. In the past, it was taken for granted that we were the masters of all living and inanimate things on earth and that we could take care of the needs of man forever. The general thought, if there was any, was: the soil, the water, and the air are ours, and no one is going to tell us what we are going to do with them. This thought still prevails in the world, but there are encouraging signs that we have reached a more mature consideration of the environmental problems that this Nation and the world face.

Whenever we pick up a newspaper, we seldom fail to see an article on the new science:

Ecology

Actually, this is not a new field of science at all. It is the study of the *home,* or, rather, the environment. The name comes from *Oikos,* meaning house, and *Logos,* which is discourse. Ecology, then, is the *Study of our House,* or, in a broader sense, our environment. This may be the total biosphere of the earth, continent, or smaller national units, such as forests, islands, or even the small world of a square foot of soil. This discipline was practiced by a rather small group of scientists, often pictured as collectors of butterflies and shells. Actually, these scientists have a true and profound curiosity—simply for the sake of knowing—about everything that goes on in nature.

They are the ones that know about the delicate balance between the living world and the environment. If we had listened to their teachings, we might have prevented many of our predicaments. We could have learned that we, too, are a part of the total systems of living and nonliving things, and that a thorough knowledge of the functioning of our *house,* or *environment,* is fundamental to our survival. Many civilizations of the past have succumbed because of a lack of understanding of the laws of nature. These laws cannot be flouted for long without severe punishment. Exhaustion of the soil and slash and burn techniques led to the downfall of early empires of the Mayas in Mexico and the Persians in Western Asia.

After finding out what substances were in the air, I could not help getting interested in their origin—where they came from and how to prevent their emission. The combination of chemical and community problems is fascinating, and I was drawn deeper and deeper into environmental pollution studies. And that is the reason why I am here today.

This evening I'll just briefly mention a few thoughts that I have had on the subject of air and our environment in general.

Our ancestors lived in the happy certainty that the earth was infinite and that there was enough soil, water, and air to go around. The system was well balanced, in a steady state of equilibrium that was not going to change much during their presence on earth. It was realized, of course, that there are some changes, some violent upheavals—storms, floods, earthquakes, births, and deaths—but they form a recurring pattern, and people get used to such a situation. The whole system seemed to have a kind of comfortable stability.

Looking at an astronaut's view of the earth, we begin to realize that the earth is actually not so large at all, and that the stability applies only to our time period, which is infinitely small compared to the time scale of geological and evolutionary happenings. A continuous flow of events led from the origin of life some two to three billion years ago to the elaborate structures that we represent. For evolutionary processes, *changes* in the environment were essential; however, for the continuation of an evolved species, the *constancy* of the environment was of great importance. Even small changes in the environment will eventually lead to the disappearance of a species, or its replacement by others more suitable to new conditions.

When organisms first climbed on land some half a billion years ago, they soon found out that the scorching sun in the daytime and the cold of the night were quite different from the protective life that they had left. And the all-pervasive supply of food in the ocean was replaced by localized supplies for which they had to hunt. When the organisms had acquired the ability to use the sun's energy, when photosynthesis had evolved, it gave them a new freedom to move without being dependent on the nutrients dissolved in the oceans. It was a

rough world for the adventurous mutants, but those that had established themselves survived in the uninhabited areas. Evolution and adaptation to the changed world went on, and today there are one to two million successful trials known—350,000 in the plant world, and at least more than one million in the animal world.

Most remarkable are the methods used to overcome the limitations set by the environment. Some of the descendants of a green alga, for example, formed an alliance with another organism, a fungus, and together they survived the new situation. The alga, living inside the fungus, is protected from the fluctuating humidity, while the fungus profits from the photosynthetic ability of the alga, which supplies it with nutrients. This combination, the lichen, was so successful that it is found in the most inaccessible and unpromising spots—on the bare rock in the deserts, as well as in the coldest regions of earth.

The less adventurous forms of life gave up their relatively safe surroundings only hesitatingly, and even today some of the present land animals, such as frogs, return to the water to assure their offspring of a better chance at life. Others found their safety in the dark areas under the surface of the earth, where the absence of large variations of light and humidity guaranteed their continued existence. Because of the stability of the surroundings, early forms of evolution found a more permanent environment in the dark and damp soil, and it now houses probably the largest supply of species, in numbers and in kind, anywhere in the world.

Actually, this soil cover shelters more life than can be found in any other stratum of any other environment on earth. The inhabitants exist in numbers that stagger the imagination.

Some years ago, some scientists blocked off a small section of forest soil in New York State[1] and removed the top layer of

earth to a depth of one inch. They made a careful count of the insects and other invertebrates found in one square foot of this top layer. In all, there was an average of some 1,400 living creatures, including 865 mites, 265 springtails, 22 millipedes, 19 adult beetles, and various numbers of 12 other forms.

Had an estimate also been made of the microscopic populations, it might have ranged up to 2 billion bacteria and many millions of fungi, protozoa, and algae in a mere teaspoonful of soil.(2)

This underworld plays an important role in the development of higher plants. It prepares the soil, the humus, into which the plants sink their roots, where they find predigested foods made by bacteria, molds, insects, nematodes, and numerous other small animals. Were it not for the work of the soil creatures, the forest would soon be choked in its own waste, and vegetation would not be possible.

The bed of mulch is rich in nutrients; a seed carried by the wind will find a place to send its roots down, and a new life emerges—maybe a violet, maybe a pine tree.

We can say that wherever there was room, some empty niche, some organism found a place to live.

The study of the adaptation of species of plants and animals to take advantage of special circumstances is most fascinating. In the family of the milkweed, for example, we find a plant that dips its roots in a rain-filled vase formed from one of its leaves. Other species (*Dischidia rafflesiana*) of the same family (*Stapelia* spp.) spread such an unpleasant odor of decomposing meat that only a certain type of fly will visit it in preference to other flowers.

The work of the scientist whom we honor today abounds with examples of the extraordinary inventiveness of the living world in taking advantage of opportunities in the environment.

In the animal world it is no different. Think of the

remarkable homes the termites build—which may be twenty or more feet high—to overcome the limitations set by nature. The termites create their own optimum environment and are first-rate air conditioning engineers. Their homes are temperature-controlled and ventilated to keep the carbon dioxide concentration down. They also are expert gardeners, and inside the mound they cultivate fungus gardens to supply the queen with nutrients.

It took the earth a few hundred million years to establish its lush vegetation and establish the concentration of the major constituents of our present-day atmosphere. In the photosynthetic processes of plants, carbon dioxide was converted to complex organic materials, and large quantities of oxygen were released into the atmosphere. In the course of millions of years, huge quantities of chemical energy were stored in these organic materials. They represent nature's stores of fossil fuels, coal, shale, oil, and gas. It was during that time that the composition of the atmosphere reached 21 percent—or 210,000 parts per million—of oxygen, and 0.03 percent—or 300 parts per million—of carbon dioxide. The living world had time to adjust itself to the gradual change from a reducing to an oxidizing atmosphere.

And, in the course of time, species came and went; some lasted only a few million years; others, such as dinosaurs, survived some 150 million years. Their contemporaries, the gingko trees and the cycads in our gardens, are still growing. They were witnesses of the struggle for existence and for power of a succession of masters of the world.

Then Came Man

And then, about a million years ago, *man came*. His early existence must have been a precarious one. His home, probably

a hole in the rocks, was all he had to protect himself from the rough environment and his enemies. His ability to master the art of making fire, and later the exploitation of the fossil fuel supplies, freed hands and freed minds to think.

Living conditions improved, diseases were conquered, man prospered, and his numbers increased rapidly. The cave became a village, the village a town, and today the towns have melted together in a new form, the "megalopolis."

It is estimated that up to about the birth of Christ, there were only two people per square mile of earth's surface. Today there are about a hundred, and by the year 2000 this number will be doubled. Such a calculation, however, gives only part of the picture. People are not evenly spread over the face of the earth. On the contrary, in urban areas the density of our present-day population has to be counted in tens of thousands per square mile.

It was the industrial revolution—the use of energy from coal and fossil fuel in general—that made this population growth possible. It was like having an army of slave workers. These modern slaves are calories or kilowatt hours or British Thermal Units. The amount of energy available to a single person, expressed in human labor, would correspond to the work of a hundred slaves. It is like Aladdin's lamp. A simple rub and there appear the slaves. A simple turn of your key in the car and several hundred horsepower, corresponding to a thousand slaves, spring into action.

This is, of course, wonderful, but the trouble is that the energy slaves are not very neat. In the process of burning our fuels we use up oxygen, but—what is more objectionable—we also add small amounts of toxic material to the air. Soot and sulfurous fumes became, in historic times, the attributes of the devil.

Pollution of the air disturbed one of the kings in England in the Fourteenth Century so much that the use of a certain type of coal was forbidden. Infringers of the rule were fined and their ovens demolished in case of repetition. One unfortunate individual was condemned to death because he had infringed on the smoke rule three times.

Some 400 years later, Joseph Priestley discovered the essential, life-giving element of the air, *oxygen,* and he made the prophetic remark:

> "Who can tell but in time this pure air may become a fashionable article and luxury, hitherto only two mice and myself have had this pleasure, privilege of breathing it. It may be peculiarly salutory to the lungs in certain morbid cases when the common air would not be sufficient to carry off the *phlogistic putrid effluvium* fast enough." (3)

These remarks were undoubtedly inspired by the heavy pollution in the industrial towns of England, and his home town, Birmingham, was just as bad as London with its black fogs.

Something had happened, and what it was I like to illustrate with the nostalgic writings of Chateaubriand, the French ambassador to England, upon a return visit to London in the beginning of the Nineteenth Century:

> "I have seen England with its old customs and its old prosperity, the small and lonely church with its tower, the cemetery, its small streets and the heather dotted with sheep. *Where is it now?*
>
> "No more woods, less birds, less fresh air. Today its valleys are obscured by the fumes of *smelters and factories.* Oxford and Cambridge take on a look of ghost towns, their colleges and Gothic chapels are half abandoned. In their cloisters among the graves of the past lie, forgotten, the marble annals of people from long ago. *Ruins guarding ruins.*" (4)

Those blackened relics stand as the tragic sins of the new era, the industrial revolution, with its thoughtless use and mismanagement of our natural resources. *A disregard of the most elementary right—the right to breathe clean air.*

This Country's Air

This, too, is the story that runs through the history of American municipalities. It is one of rapid growth in population and industrial activity, marked by wastefulness of material resources, carelessness in regard to the future, indifference to many things of life, and a blind opposition toward anything that seems to threaten, in even a remote way, that which is termed prosperity.

A panoramic view of most of our large cities as seen from their skyscrapers shows a grayish and brownish fog limiting visibility to only a few miles. This is seen in New York, as well as in Los Angeles, London, or Yokohama, to name only a few of the affected areas. Air pollution has become a normal aspect of urban living, and it has brought with it irritation of the throat, nose, and eyes, and in some instances has caused death.

The end of 1967 witnessed an exciting event when the population counter went to 200 million in this country. The press was jubilant about the accomplishment: More people meant more business, more cars sold, more building, and more advertising. To many this was prosperity; to others it was a day of gloom, a day that shows with deadly accuracy what our fate will be many years ahead. The population curve is going up without wavering.

Every 9 seconds a baby is born; every 16½ seconds someone dies. This means four more persons every minute, or 250 per hour, 5,600 per day. There are no cease-birth agreements, no holidays in this business. In one year there are some two million more mouths to feed—a line of baby carriages stretching from New York to Los Angeles. With computer accuracy, we will celebrate the 300 million

mark in only a few decades. Sixty-five percent of these people are concentrated in the big cities, and most of them are subject to some degree of air pollution. Burning of fuels adds particulate matter in the form of soot or ash, and gases such as carbon dioxide, carbon monoxide, and oxides of nitrogen and of sulfur.

The concentration of people in cities has affected the meteorology or the climate within the built-up area. With many combustions going on, with a decreased wind circulation, and with a poor reflection of the sunlight, the temperature inside the cities is raised considerably over that of the surrounding rural area. This increase in temperature may be several degrees Fahrenheit. An interesting byproduct of this rise in temperature is air circulation driving pollutants towards the center of the city.

Due to the polluted atmosphere, the solar energy received by the area may be in the order of 20 percent, and a loss of half of the visible radiation and two-thirds of the ultraviolet radiation is not rare at all.

Atmospheric and terrain conditions that lead to a lack of ventilation occur far more frequently than most people realize, and it is not strictly necessary to have mountains to obstruct the flow of air. The streets in our metropolitan areas act as small canyons, and on windless days relatively high concentrations of pollutants are found there.

The pollution problems in our cities are aggravated by other larger scale meteorological phenomena. In many areas, especially on the Pacific Coast, the sinking or subsidence of air causes it to heat up slightly, and a condition is established by which the warm air is lying on top of a colder ground layer. This type of inversion layer ranges from a height of a few hundred feet to a few thousand.

In other areas the earth radiation of heat during the night causes strong ground inversion. In both cases, pollutants caught in this colder layer refuse to rise and, consequently, create air problems.

It has been established that this existence of an inversion base within 500 feet of the surface occurs on more than 50 percent of the nights in a year over most of the United States.

Under these conditions of limited ventilation, pollutants are held to the ground and are especially bothersome.

Effects of Air Pollution

The effects of the pollutants are many. Irritation of the throat and eyes, haze, and damage to vegetation are frequent. In addition, there is a quite serious effect that does not have the glamour of some of the more dramatic impressions of pollution, and that is the *damage to materials*. It is difficult to assess the value of the damage done, and the cost of repairing the damage, but it is certain to run into many billions of dollars per year. In a number of instances the damage can never be undone.

The simultaneous oxidative and reductive processes, or alkaline and acid atmospheres, do not respect any material, be it stone, paint, cloth, or various metals. Since the industrial revolution, art works have suffered irreversible damage. A frieze on the Parthenon in Athens, from which a plaster cast was made in 1802, shows the relatively minor damage that occurred during its first 2,240 years. A photograph of the same marble taken in 1938 is almost unrecognizable because of the rapid deterioration during the intervening 136 years of the industrial age. Building materials nowadays have to be chosen so as to withstand the onslaught of pollution. Deposits of chemicals eat their way into the smooth surfaces

of metals, acting directly by setting up tiny electrochemical cells to pit and mar the surface.

Stones are corroded by normal weathering accelerated by pollutants; smoke and tarry deposits adhere to buildings and produce the unsightly and depressing look of an old city.

Oxides of sulfur, common pollutants of air in all urban communities, cause deterioration of metals and building materials. They attack marble and carbonate-containing stone; corrosion of building stone statuary is common all over the world; and in many cities conservationists are moving works of art indoors to protect them from the action of acidic pollutants. It is reported that Cleopatra's Needle has deteriorated more since its arrival in New York in 1881 than it did during three thousand years spent in Egypt.

Calcareous materials such as limestone, marble, lime plaster walls, and frescoes are subject to chemical assault by the sulfuric acid formed from moisture and sulfur oxides. The calcium carbonate in the stone converts to calcium sulphate and its hydrated form, gypsum, both of which are water soluble. In the process, the volume of the stone expands by 70 percent. Stress and leaching result, and ultimately the stone crumbles. Granites and sandstones are not similarly affected.

J. V. Noble, from the Metropolitan Museum, explicitly implicated air pollutants when he wrote:

> "The presence of various forms of sulfur in the air is particularly injurious to limestone and marble. There is an appreciable, visible etching on marble. . . . I would say that all the exposed stonework of ancient elements at the Cloisters has deteriorated since its erection in New York City as a direct result of air pollution. . . . It is pointless to collect outstanding works of art, many over a thousand years of age, if one thousand years from now they are going to be so badly deteriorated to be virtually worthless."[6]

The situation in a museum that houses a collection of objects valued for their artistic or historical value presents a problem quite different from that of protecting consumer goods. In this case, the materials exposed to the atmosphere represent the whole spectrum of products used by men—products from plant, animal, or mineral origin, natural and synthetic dyes, fabrics and paint, metals and plastics.

Libraries, as well as art museums, are concerned about the effects of air pollution. The same acid atmosphere in New York City that decomposes the Egyptian statuary outside the Metropolitan Museum of Art also decomposes the pages of old books stored in the City's Central Research Library on Fifth Avenue. E. G. Freehafer, Director of the New York City Public Library, has estimated that about 1.8 million of the 4.8 million volumes in the Central Research Library are in an advanced state of deterioration. Air pollution is a prime factor in this problem, and the City Library has spent $900,000 since 1952 to microfilm decaying books.[5]

What Is Being Done

The sources of the problem are well known—too many cars, too much industry, and too many people. Federal, State, and local agencies are all engaged in air pollution control. Severe restrictions have been placed on industries, and a strict program of automobile control is under way. By 1975, the new cars will be largely controlled. There is still, of course, the large number of older, partly controlled vehicles, but there is every reason to expect that methods will be found to reduce their emissions, too.

Even though the control authorities are doing a job unequaled in the world, the trouble they are facing is the

explosive growth. Every year there is the equivalent of one more city of nearly two million people, plus their industry, plus their cars, to control, when we have not even caught up with the old pollution. This is a gigantic task.

But while some of us are trying to master the air-pollution problems, other trouble spots appear. New problems arise in the demand for more products from our land. Intensive cultivation demanded the use of insecticides, herbicides, and nematicides, but because of careless use of such substances DDT has turned up in penguins in the South Polar regions and, I am sure, in us, too. And a modern version of the children's story sounds like this:

> "The bird eats the fish that ate the plant that ate the DDT that man made."

It has upset the soil flora and fauna, which we have seen are essential for the preparation of the environment of the roots of higher plants. To the chemist, DDT is only 2-dichlorodiphenyltrichloroethane, and he is proud that he has found a more toxic chemical than any before. He probably never asked what happened to the use that is made of his synthesis. Recent experiments [6] have shown that the toxic chemicals destroy part of the *underground* workers. The recovery is a slow one, taking sometimes a year or more.

Preventive Conservation

It has become clear that, for the future, we shall have to do more than follow a system of repair. Unpopular as it may be, the further expansion of our city has to be planned with the avoidance of further air pollution in mind. Air-polluting industries may have to be located elsewhere. A revision of our Nineteenth Century thinking on transportation is in order.

Many things can be thought of by laymen, but the *constructive* thinking by experts in city planning and city government is needed to come up with a plan that the community will *buy*.

The new deal in conservation of our resources is a *planned and preventive conservation*. Planned because water, air, and soil belong together. An air-pollution problem is not solved by dumping the effluent into our rivers or estuaries. A water-pollution problem is not solved by draining the toxic components into the soil. Preventive conservation is much less expensive than restorative conservation. More important, as has been said, "some ecologies, once destroyed by man, can never be brought back no matter what we do." All our billions, all our technology can never bring back the tons of topsoil from the Gulf of Mexico to the American heartland. Nor can we ever bring back a single acre of wilderness once it is destroyed. There are no instant ecologies or instant forests. We must assess each new and old technological development for its ultimate impact on man.

Crystal-ball gazing is a risky business. Only 30 years ago, I did not dream of seeing the other side of the moon. Now we have not only seen it, but we have an accurate analysis of moon dust. Technology has advanced so much that what will happen even in such a short time span as 30 years is unpredictable. The next generation might laugh about our clumsy efforts to reach the moon, while they commute in Buck Rogers fashion through space. The problems of pollution will long have been solved. When this present era of our struggle for clean air and water is discussed in school, pupils may be mildly amused.

The future development and new ideas will all be based on a further expansion of our *technology* and increase in our *knowledge*. This is wonderful, but there is one thing we

should realize. There is an urgent need for a *technology in handling our human affairs, too.* It is this aspect that has been lacking sadly in recent years. We must correct this before technology becomes our master instead of our servant, and civilization suffers incalculable damage. *This should not be, and it does not have to be.*

Actually, tremendous progress has been made. We realize now that direct engineering control, necessary as it is, is only treating a symptom. It is like taking an aspirin for a chronic headache. The real trouble is much deeper. And an exciting and hopeful sign is that we are now questioning the underlying causes of our predicament.

We are now critically examining the dogmas of the past, and one of these is: Is growth the indication of prosperity, is it the ideal that we should strive for? Are more people, more goods used or wasted, *progress?* Or do we have to improve the quality of our life?

Such questions were taboo only a few years ago. Nowadays we can raise them without being branded radicals.

Will we succeed? I believe so. The quiet, rather remote scientist has been joined—or rather overrun—by a new breed of ecologist, who is primarily interested in preserving the environment for man's sake and concerned about the role man plays in this environment for his own good, as well as for the good of all. The movement has been joined by activists in harmony with the times. Businessmen, newspapers, magazines, public companies, and TV are cashing in on the "Clean Deal" for our environment. The flood of literature is overwhelming. Headlines tell you that "Death Stalks the Streets of Los Angeles," and how "A City Drowned in Dragon's Breath," meaning automobile exhaust.

Even a new vocabulary has been developed. I read recently about Ecocide and Terracide, apparently derived from

homicide and suicide. Then there is Ecotactics; and a related new creation is "Poppulution."

Prophets predicting imminent disaster have for several years outdoomed each other; the record stands now at two years. A more balanced view, written for the *Washington Post* (7) by William S. White, gives us more hope and more time to correct our error. He writes:

> "There is no deeper trait in the American character than that of ignoring a great problem beyond all reason and season and then overnight leaping at it with shrieks of frenzy and hysteria. We lock the barn door not only after the horses are all out and running away, but are also running away in many different directions."

The only useful way to cope with a frightful and frightening condition is to recognize it for what it is, without, at the same time, falling into a paroxysm of self-inflicted terrorism that can do nothing but harm to all concerned.

Still, this is precisely the mass neurosis in which, as a Nation, we seem about to plunge as new-found Cassandras emerge from behind the potted palms of lecture halls to vastly overstate a real state of affairs that is quite bad enough in itself.

I see the present concern and active participation of young and old as a most cheerful sign. It was not so long ago that one could count the academically trained environmentalists on the fingers of his hand. Today, universities compete in expressing their eagerness to enter the ecological field. This general concern, when led by responsible leaders, is already paying off. Corrections of our sins against our natural resources, the organic and inorganic world, are underway. It will take time.

In chemical reactions, a certain activation energy is necessary to start a reaction. This is, in a way, quite fortunate. If this were not so, our fats, sugars, and protein would combine with oxygen and we would all disappear in a flash.

The art of the chemist is to manage the reaction once it has started so that he does not blow out the windows of his laboratory. The same is true of our efforts to restore and conserve our environment. It is the task of our leaders, government, and others to direct this energy into useful channels and not into precipitate actions that do more harm than good.

The people have spoken, and it is my belief that, by and large, government and industry are responding. To some of us, the efforts are unevenly divided and do not have the priorities they deserve. Bad practices ingrained over hundreds of years are not corrected overnight. The task ahead requires devotion and sacrifices, but the reward of breathing clean air is worth it.

Clean air is everybody's business, and everyone has to join the battle for intelligent use of our resources—land, water, and soil. Support those in government who are willing to pass legislation necessary to protect our natural resources. Support the officials who try to enforce the rules and regulations. They are fighting in the front line and have to take the brunt of the opposition. They need your support. They are there to help you.

But above all, *educate*. Education has a top priority, for only an enlightened public can make the right decisions. This education begins in kindergarten and keeps on for the rest of your life. For those who need an extra push, listen to this poem written by a mathematician, R. S. Scorer, at Oxford University:

> "We know what does the damage and we know what is not good.
> But nothing is done, because it is not completely understood.
> We have the know-how and the wealth, but do nothing until
> Our view of life provides us also with determined will.
> We are fallible, of course, but must we always gasp for breath
> Until we fully understand the chemistry of death."[8]

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Dr. Arie Jan Haagen-Smit, the 1970 B.Y. Morrison Memorial Lecturer, is a brilliant biochemist and educator and an air pollution militant. He was instrumental in launching man's first serious attempt to combat air pollution.

Professor of bio-organic chemistry at the California Institute of Technology, Pasadena, since 1937, Dr. Haagen-Smit is Chairman of the President's Task Force on Air Pollution. He also chairs California's Air Resources Board.

In the late 1940's, his research established the causes of the irritating Los Angeles smog. He pinpointed smog as the cause of serious plant damage, and for the first time tagged automobile exhaust as a prime cause of smog.

He has taken his knowledge and concern beyond the laboratory to battle air pollution at local, State, and national levels, and to urge planned control of industrial expansion and population concentration.

Now a naturalized U.S. citizen, Dr. Haagen-Smit was born and educated in the Netherlands. He first won distinction in research by isolating various plant hormones and other substances important to an understanding of plant growth.

Honors paid him include the Knight Order of Orange, Nassau, of the Netherlands Government, the Fritzsche Award of the American Chemical Society, and awards from the Air Pollution Control Association of America, the Daughters of the American Revolution, and the Smithsonian Institution.

Previous Lecturers

1968 Mrs. Lyndon B. Johnson addressed the American Institute of Architects in Portland, Oregon.

1969 Mr. Patrick Horsbrugh, Professor of Architecture and creator of the Graduate Program in Environic Studies at Notre Dame University, addressed the General Federation of Women's Clubs in Cleveland, Ohio.

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